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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

AUG 18 1995

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

In the Matter of)

)
Replacement of Part 90 by Part 88 to)
Revise the Private Land Mobile Radio)
Services and Modify the Policies)
Governing Them)

PR Docket No. 92-235

and)

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)
Examination of Exclusivity and)
Frequency Assignment Policies of)
The Private Land Mobile Radio)
Services)

To: The Commission

PETITION FOR RECONSIDERATION

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SUMMARY

SEA hereby petitions the Commission to reconsider certain technical rules adopted in the Report for the 150-174 MHz and 421-512 MHz bands. SEA herein reviews the progression of choices made by the Commission based on the guidance of commenters in this proceeding and points out where SEA believes several key technical errors have been made.

First, SEA takes issue with the frequency stability rules adopted for 6.25 kHz channel bandwidth equipment. The limits adopted are overly restrictive, resulting in an undue burden on equipment manufacturers to offer economical equipment. SEA reviews the Commission's rationale in adopting these limits and questions its wisdom and proposes modifications to the frequency stability rules.

Second, SEA points out that the band plan adopted in the Report will require geographic separation between adjacent 6.25 kHz-spaced channels in the 450 MHz band. This is because 6 kHz authorized bandwidth is simply too large for 6.25 kHz-spaced channels. SEA requests reconsideration of the 6.25 kHz emission mask in order that same-area adjacent 6.25 kHz channels may be possible.

Third, SEA petitions the Commission to make modifications to the spectrum efficiency standards adopted in the Report.

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| The Private Land Mobile Radio |) | |
| Services |) | |

PETITION FOR RECONSIDERATION

SEA Inc. ("SEA"), by its undersigned counsel, hereby files this Petition for Reconsideration ("Petition") in response to the FCC's Report and Order and Further Notice of Proposed Rule Making ("Report") in the above captioned proceeding.^{1/}

INTRODUCTION

SEA Inc., a wholly-owned subsidiary of Datamarine International, Inc., is a manufacturer of narrowband land mobile radio equipment. SEA has submitted comments in numerous rulemaking proceedings affecting mobile radio users, including the original Notice of Proposed Rule Making in this proceeding.^{2/} Additionally, SEA has provided

1/ Report and Order and Further Notice of Proposed Rule Making, PR Docket No. 92-235, released June 23, 1995.

2/ Notice of Proposed Rule Making, PR Docket No. 92-235, November 6, 1992.

technical guidance to the Commission during open forums such as the FCC's Refarming "brown bag lunch" and Refarming Roundtable discussions. Since 1981, SEA has been involved in the development of 5 kHz narrowband technology for land mobile at the technological and regulatory levels. SEA manufactures and markets narrowband linear modulation wireless equipment used in voice and data operations in 5 kHz wide channels on 220 MHz Private Land Mobile Radio (PLMRS) frequencies. SEA has type accepted narrowband mobile, base and portable products for the 220-222 MHz frequency band.

SEA's experience in introducing systems and products into the 220-222 MHz band makes the company uniquely qualified to discuss the introduction of narrowband technology into the PLMRS bands below 800 MHz. Indeed, no other manufacturer has a track record of narrowband product development and system implementation which comes close to matching that of SEA.

The rules adopted in the Report are based on a bandplan using 6.25 kHz and 12.5 kHz channel widths. SEA supported a 5 kHz narrowband bandplan during the comment phases of this proceeding, and in so doing focussed on the merits of 5 kHz.^{3/} In adopting a 6.25 kHz narrowband channel bandwidth plan, nearly all of the advantages

3/ See the Comments of SEA and Reply Comments of SEA. A 5 kHz channelization would permit the ability to retain currently assigned channel centers, to split 15 kHz or 25 kHz channels into multiple (3 or 5) narrowband channels in a way that would be benign to adjacent channel neighbors, and to maintain a common narrowband channel spacing in both the 150-174 MHz and 421-512 MHz bands. In addition, the emission mask proposed by the Commission for 5 kHz channels would have permitted same-area adjacent channel operation for 5 kHz-spaced systems. Finally, 5 kHz-spacing would have resulted in 50% more narrowband channel assignments in the 150-174 MHz band and 25% more narrowband channel assignments in the 421-512 MHz band than the rules adopted in the Report.

that would have been possible with a 5 kHz plan are lost. Nevertheless, SEA acknowledges and appreciates that there were many competing objectives and viewpoints that had to be considered, not the least of which were the problems facing users in managing a transition from present technology to new technology. All things considered, SEA is prepared to accept the Commission's decision regarding the bandwidth question. However, and most importantly, in SEA's view there are a number of serious technical problems inherent in the rules as adopted. If left to stand, SEA believes these technical problems will seriously inhibit, and possibly prohibit, the introduction of spectrum efficient narrowband technologies in the "refarmed" bands and undermine the Commission's intention to provide mechanisms for exclusive use channels. SEA offers the following recommendations in order to mitigate what SEA considers to be serious shortcomings in the rules adopted in this proceeding.

DISCUSSION

I. THE FREQUENCY STABILITY LIMITS SET FORTH IN ¶ 90.213 FOR 6.25 kHz CHANNEL BANDWIDTH EQUIPMENT ARE UNNECESSARILY RESTRICTIVE AND THE COMMISSION SHOULD THEREFORE RECONSIDER THEM.

SEA takes issue with the frequency stability rules adopted for 6.25 kHz channel bandwidth equipment. SEA submits that the limits adopted for mobiles are overly restrictive. The narrowband limits adopted in ¶90.213(a), footnotes 5, 6, 7, and 8, are shown below in Table A:

Table A
FCC - adopted 6.25 kHz channel width
frequency stability limits

| Frequency <u>band</u> | Fixed and base <u>stations</u> | <u>Mobile</u> |
|--------------------------|-----------------------------------|---------------|
| 150-174 MHz | 1.0 ppm | 1.0 ppm |
| 421-512 MHz | 0.1 ppm | 0.5 ppm |

The original NPRM proposed 0.1 ppm for base and 1.5 ppm for mobiles at 150 MHz, and 0.1 ppm for base and 1.0 ppm for mobiles at 450 MHz. SEA supported those proposed limits because they were reasonable for the channel spacings and emission masks proposed in the NPRM, and because such tight limits are required for same-area use of adjacent channels. The rules that were adopted for mobiles, however, are more restrictive than those proposed, and unnecessarily so. This specification will place an undue burden on mobile equipment design.

The 6 kHz authorized bandwidth leaves a mere 250 Hz guard band between nominal (zero frequency error) edges of the authorized bandwidths of two adjacent 6.25 kHz-spaced narrowband channels, as is the case in the 421-512 MHz band. Further, the emission mask adopted by the Commission for 6.25 kHz and 12.5 kHz channels will actually *overlap* when placed 6.25 kHz apart, illustrating the problem at 421-512 MHz created by the new rules, as shown graphically in Figures 1 and 2 below. It should be noted that receiver modulation acceptance bandwidths must be wider than the authorized bandwidths represented by the emission masks shown below in Figures 1 and 2.

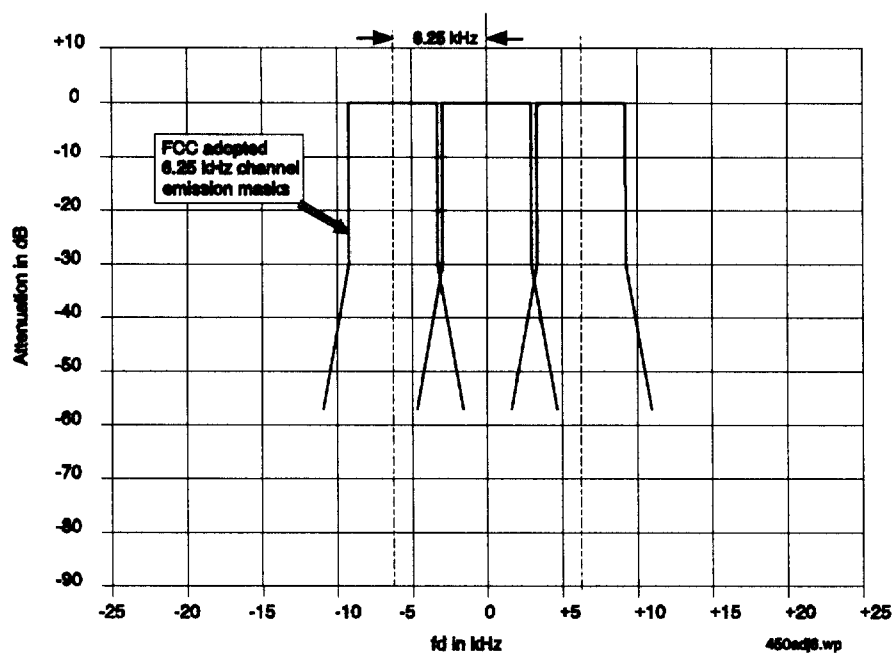


Figure 1
6.25 kHz channel bandwidths spaced 6.25 kHz

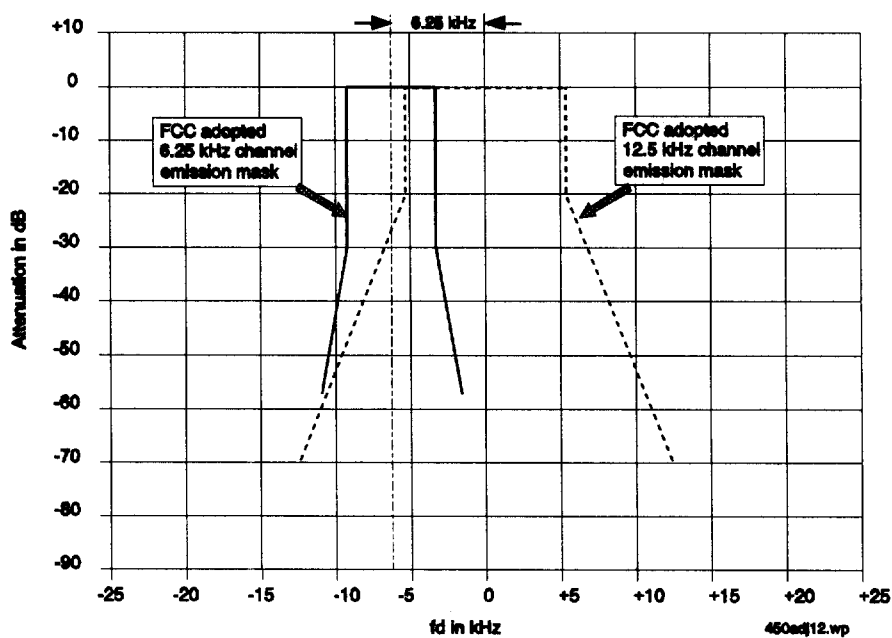


Figure 2
6.25 kHz and 12.5 kHz channel bandwidths spaced 6.25 kHz

It is immediately apparent from the foregoing illustrations that geographic separation will always be required between adjacent narrowband systems that operate in the 421-512 MHz frequency band. Tight frequency stability limits would, therefore, achieve nothing with regard to adjacent channel protection, since adjacent channels cannot coexist in the same area.

In the 150-174 MHz band, the narrowband-to-narrowband channel spacing adopted by the Commission is 7.5 kHz. This leaves a 1.5 kHz guardband between 6.25 kHz channel bandwidth (6 kHz authorized bandwidth) channels, which places the channels far enough apart for same-area use. Frequency stability, therefore, must be a consideration in the 150-174 MHz band in order to avoid the influence of frequency drift on adjacent channel interference. The frequency stability limits, however, need not be as tight as those adopted in the Report. When a narrowband system is placed 7.5 kHz offset from a 12.5 kHz bandwidth channel, the emissions will overlap, which means that geographic separations will be required. As a result, the choice of frequency stability limits is not a factor when a narrowband system is placed 7.5 KHz offset from a 12.5 kHz bandwidth channel. In summary, the only case that needs to be analyzed when considering the selection of a frequency stability limit is that of 7.5 kHz-spaced 6.25 kHz channel bandwidths. SEA has performed an analysis in Appendix A attached hereto to develop a suitable frequency stability limit for 7.5 kHz-spaced, 6 kHz authorized bandwidth channels in the 150-174 MHz band.

Therefore, if the Commission insists on maintaining the channel plan and emission masks adopted in the Report, SEA recommends the Commission revise the frequency stability limits for 6.25 kHz channel bandwidth equipment as set forth below in Table B.

Table B
SEA's modified 6.25 kHz channel width
frequency stability limits

| <u>Frequency</u> <u>band</u> | <u>Fixed and base</u> <u>stations</u> | <u>Mobile</u> |
|---------------------------------|--|---------------|
| 150-174 MHz | 1.0 ppm | 2.0 ppm |
| 421-512 MHz | 0.5 ppm | 1.0 ppm |

The above limits are wholly adequate to accomplish the objective and are much more reasonable in that they will enable manufacturers to produce more economical equipment than with the limits adopted in the Report. If the Commission acts on no other questions raised in this petition, SEA urges the Commission to reconsider the frequency stability limits.

In a related matter, SEA recommends the Commission include language in ¶90.213 "Frequency Stability" which permits mobile units to utilize the signal from associated base stations to achieve the specified frequency stability. This would be similar to the provision in the previous version of this paragraph (footnote 18) as relates to the 220-222 MHz band. Furthermore, the Commission inadvertently left this provision for 220-222 MHz out of the re-write of Part 90 attached to the Report, and SEA requests that it be reinstated. Specifically, the sentence "Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability" should be restored with respect to

the 220-222 MHz band, and should be adopted with respect to all frequencies in the bands 150-170 MHz and 421-512 MHz.

II. BECAUSE OF THE SELECTION OF QUESTIONABLE EMISSION MASKS, GEOGRAPHIC RESTRICTIONS WILL BE NECESSARY FOR ADJACENT CHANNELS, AND THE COMMISSION THEREFORE SHOULD RECONSIDER THE EMISSION MASK FOR 6.25 kHz CHANNEL WIDTHS

As discussed above, the band plan and emission masks adopted in the Report will require geographic separation between adjacent 6.25 kHz-spaced channels in the 450 MHz band. This is because 6 kHz authorized bandwidth is simply too large for 6.25 kHz-spaced channels.

The Commission should be aware that, at the very least, the necessity of geographic separation will make any spectrum efficiency benefits in converting to 6.25 kHz channels difficult to quantify. At worst, there may be no benefits^{4/}. SEA requests the Commission to reduce the authorized bandwidth for 6.25 kHz channel bandwidth emissions from the adopted 6 kHz, back to the originally-proposed 5 kHz authorized bandwidth. This would make same-area adjacent 6.25 kHz channel operation possible

^{4/} The Commission seems to recognize that its adopted bandplan incorporates these flaws, but only to the extent that it is an issue during the transition from current to new channel assignments. See Report, at 39,40. "The level of interference protection provided by the frequency separation between current assignments and new assignments using frequencies resulting from channel splitting may not be sufficient to permit same-area high-power operation." The discussion in the Report indicates that, based on this issue, it will be up to the coordinators to decide on geographic separations and power limits, and that further regulatory action might be required.

in the 421-512 MHz band.^{5/} The same narrowband emission mask (5 kHz authorized bandwidth) should be used for the 150-174 MHz band so that there will be a common mask for both bands, thereby enabling equipment compatibility for multimode radios.

The Commission's intent in setting the narrowband authorized bandwidth to 6 kHz was, based on the advice of TIA, "...to accommodate a 9600 bits per second CQPSK signal."^{6/} But the benefit is clearly illusory, since same-area operation is simultaneously made impossible.

By reducing the authorized bandwidth to 5 kHz, the Commission will not jeopardize the successful development of data and digital modulation technologies on narrowband channels. Data rates of up to 8 kbps can be supported using QPSK in 5 kHz authorized bandwidths, far exceeding the efficiency standard for data and capable of trunked digital voice operation. Additionally, 5 kHz authorized bandwidths will support up to 12 kbps using 8-PSK and up to 16 kbps using 16-QAM.

5/ Tighter frequency stability limits than those expressed in Table B above (SEA's recommended limits) would be required for the 421-512 MHz band. SEA recommends 0.1 ppm base/1.0 ppm mobile limits should the Commission reconsider and adopt a 5 kHz authorized bandwidth. See Appendix A for an analysis of the use of 5 kHz authorized bandwidth in the 421-512 MHz band. SEA continues to recommend the limits of Table B for the 150-174 MHz band, even if the authorized bandwidth for narrowband channels were reduced to 5 kHz.

6/ See Report at 41.

III. THE ADOPTED EFFICIENCY STANDARD MUST BE MODIFIED TO GIVE IT CLARITY

The efficiency standard adopted is less than meaningful because, with 6.25 kHz/12.5 kHz channel spacing such as that in the 450 band, the emission masks are such that a "12.5 kHz channel" uses almost as much spectrum as three 6.25 kHz channels^{7/}. Given the adopted masks, a 12.5 channel width channel, in SEA's view, cannot be considered equivalent in efficiency to two 6.25 kHz channels. This is graphically evident from the figure below.

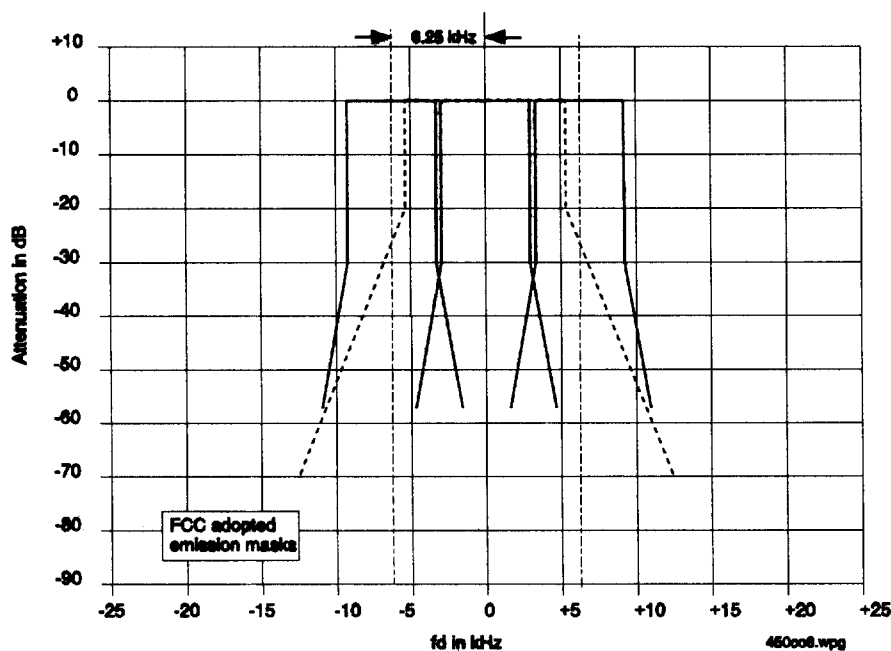


Figure 3

Three 6.25 kHz channel bandwidth emission masks superimposed on a single 12.5 kHz channel bandwidth emission mask

^{7/} That is, a 12.5 kHz channel must be considered "co-channel" to the associated on-channel 6.25 kHz channel and both adjacent 6.25 kHz channels.

This said, SEA appreciates that there were many competing viewpoints that were taken into account by the Commission in reaching its decision, and SEA acquiesces in the conclusions on this matter as set forth in the Report. SEA, however, recommends some changes in the wording of the efficiency standard, which should help achieve what SEA believes are the goals of the Commission.

RECOMMENDATION 1:

The text of new ¶90.203(j)(3) introduces what appears to be a new term: "overall bandwidth". SEA is familiar with the terms "channel bandwidth," "authorized bandwidth," "necessary bandwidth" and "occupied bandwidth" as they relate to this proceeding. We recommend the Commission change the term "overall bandwidth" to "channel bandwidth," which is consistent with terminology used elsewhere in ¶90.203 and in ¶90.210.

RECOMMENDATION 2:

The text of new ¶90.203(j)(3) and ¶90.203(j)(5), describing the efficiency standard details and deadlines, indicates an apparent *either/or* situation with regard to voice channel equipment efficiency and data channel equipment efficiency. For instance, ¶90.203(j)(5) states:

"On or after January 1, 2005, requests for Part 90 type acceptance of transmitters designed to operate on frequencies in the 150-174 MHz and 421-512 MHz bands must include certification that the equipment meets a spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth. If the equipment is capable of transmitting data and has an overall bandwidth of 6.25 kHz or more, the equipment must be capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of bandwidth."

SEA recommends the text of ¶90.203(j)(5) be modified as follows, with similar modification to ¶90.203(j)(3) (additions italicized, deletions struck out):

"On or after January 1, 2005, requests for Part 90 type acceptance of transmitters designed to operate on frequencies in the 150-174 MHz and/or 421-512 MHz bands must include certification that the equipment meets a spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth. *Additionally*, if the equipment is capable of transmitting data and has ~~an overall channel~~ bandwidth of 6.25 kHz or more, the equipment must be capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of *channel* bandwidth."

Note that the word "additionally" is included in the Commission's description of this clause in the discussion section of the Report.^{8/} SEA believes that the recommended language will help preclude any attempted skirting of the rules by those who might claim that a 12.5 kHz channel width 9600 bps digital voice radio actually transmits 9600 bps data. Such a radio might appear to meet the data efficiency standard, while in reality only achieving one voice channel per 12.5 kHz. SEA believes these changes would, indeed, make this rule achieve the Commission's intent.

SEA notes that the efficiency standard adopted is weaker for equipment in the 150-174 MHz band than it is for equipment in the 421-512 MHz band. This is because, even though the 150 MHz band makes use of "6.25 kHz" and "12.5 kHz" channel bandwidth equipment, the channel spacing is in fact 7.5 kHz and 15 kHz at 150 MHz. SEA recognizes that there were countervailing factors which prompted this result, but notes nevertheless that this amounts to a squandering of spectrum as a result of not choosing

8/ See Report at 47.

a 5 kHz-based band plan. Had a bandplan based on 5 kHz channel bandwidths been adopted, the narrowband channel spacing could be common between VHF and UHF.

CONCLUSION

The Commission should now take the time to reconsider the rules it seeks to adopt in this Report. Clearly, the rules as reflected in the Report do not achieve the goals stated at the outset of this proceeding, "...to provide technical flexibility which enhances deployment of new technologies..."^{9/}, "...to create policies which address the diverse communications requirements of...private wireless users..."^{10/}, and "...to create incentives to encourage the efficient and intensive use of the spectrum..."^{11/}. It is quite evident that the channel spacing, emission masks and frequency stability limits adopted favor the introduction of but one new technology: 12.5 kHz bandwidth equipment. It is also clear that this technology does not offer substantial improvement in the level of spectrum efficiency that currently exists in the PLMRS bands below 800 MHz. At the very least, therefore, the Commission should correct the flaws of the rules as adopted in the

^{9/} See Report at 3.

^{10/} Id. at 4.

^{11/} Id. at 3.

Report so as not to preclude the introduction of alternative technologies, including those that would operate on narrower channel spacings.

Respectfully submitted,

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Attachment: Appendix A

August 18, 1995

APPENDIX A

Derivation of suitable frequency stability limits for 150-174 MHz 6.25 kHz channel bandwidth equipment, based on 6 kHz authorized bandwidths and for 421-512 MHz 6.25 kHz channel bandwidth equipment, based on 5 kHz authorized bandwidths

INTRODUCTION

The band plan and technical service rules for the 220-222 MHz band was adopted based on the comments of many. Considered were the comments of United Parcel Service, Advanced Mobilecom Inc., Motorola and SEA. We believe the thought and reasoning put into the development of the service rules for the 220-222 MHz band as well as the real world experience obtained since the rules' adoption justifies their use in defining a frequency stability limit for narrowband mobiles in the refarmed bands.

This analysis is based on the fundamental criterion that the channel spacing, emission mask and frequency stability must be such that same area adjacent channel use is required.

220 MHz BAND

At 220 MHz, the channel spacing (CS) is 5 kHz and the authorized bandwidth (ABW) is 4 kHz, making the guard band (GB) 1 kHz.

$$(1) \quad CS - ABW = GB, 5000 \text{ Hz} - 4000 \text{ Hz} = 1000 \text{ Hz}$$

The worst case degradation of adjacent channel immunity occurs when the desired channel frequency drift and the undesired channel frequency are maximum in opposite directions, e.g., the upper adjacent channel transmitter has drifted low and the desired channel has drifted high. The total relative frequency drift (RFD), or encroachment on the guardband, is twice the frequency stability limit. The total drift of the two channels towards one another is twice the mobile frequency stability (MFS) limit times the rf frequency.

$$(2) \quad RFD = MFS \times 2 \times RF$$

For 220 MHz, $RFD = 1.5 \text{ ppm} \times 2 \times 220 = 660 \text{ Hz}$.

For this analysis, the relationship between the guardband reserved between channels and the total relative frequency drift is called the guardband encroachment factor and is defined as:

$$(3) \quad GEF = RFD/GB.$$

For the 220 MHz band, $GEF = 660\text{Hz}/1000\text{Hz} = .66$. SEA asserts that this factor represents adequate protection for same-area adjacent narrowband channel use.

Combining the above expressions and solving for MFS yields a formula for determining the frequency stability which would yield equivalent performance to that in the 220 MHz band.

$$(4) \quad MFS = GEF \times \frac{(CS - ABW)}{2 \times RF}, \text{ where } GEF = .66$$

THE 150-174 MHZ BAND: 6 kHz Authorized Bandwidth

In the 150-174 MHz band with 6 kHz authorized bandwidth and 7.5 kHz channel spacing, $MFS = .66 \times (7500 - 6000)/(2 \times 174) = 2.84 \text{ ppm}$.

SEA, therefore, recommends 2.0 ppm mobile frequency stability for 150-174 MHz, which is about 30% tighter than the 220 MHz equivalent calculated above.

THE 421-512 MHZ BAND: 5 kHz Authorized Bandwidth

In the 421-512 MHz band, same-area adjacent 6.25 kHz spaced channels could operate if the authorized bandwidth were modified to 5 kHz. Using formula 4 above, the mobile frequency stability for $RF = 450 \text{ MHz}$ should be $MFS = .66 \times (6500 - 5000)/(2 \times 450) = 1.1 \text{ ppm}$. At 512 MHz the MFS calculates to 0.97 ppm. SEA recommends 1.0 ppm mobile frequency stability in the 421-512 MHz band when used with a 5 kHz authorized bandwidth.

CERTIFICATE OF SERVICE

I, Deirdre Johnson, hereby certify that on this 18th day of August, 1995, copies of the foregoing "Petition for Reconsideration" were mailed, postage prepaid, to the following:

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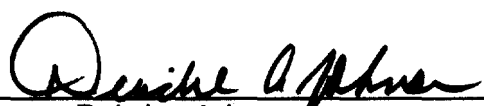
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